May 29, 2019

Email: [redacted]

Dear [redacted]

Re: Request for Access to Information under Part II of the Access to Information and Protection Privacy Act (the ATIPP Act, 2015)

On April 30, 2019, the City of St. John's received your request for access to the following information:

> *Any reports, memos, studies, action plans, or pilot projects related to corrosion control in St. John's water distribution network. This includes any such documents related to either pH adjustment or orthophosphate dosing of drinking water in order to reduce corrosion in water mains, as well as lead levels at resident's taps.*

Enclosed is the information you requested. Please be advised that you may ask the Information and Privacy Commissioner to review the processing of your access request, as set out in Section 42 of the ATIPP Act. A request to the Commissioner must be made in writing within 15 business days of the date of this letter or within a longer period that may be allowed by the Commissioner:

> Office of the Information and Privacy Commissioner
> 2 Canada Drive; P. O. Box 13004, Stn. A, St. John's, NL. A1B 3V8
> Telephone: (709) 729-6309; Facsimile: (709) 729-6500

You may also appeal directly to the Supreme Court Trial Division within 15 business days after you receive the decision of the public body, pursuant to Section 52 of the Act.

If you have any further questions, please feel free to contact me by telephone at 576-8429 or by e-mail at kcutler@stjohns.ca.

Yours truly,

Kenessa Cutler

Kenessa Cutler
ATIPP Coordinator

St. John's Water Treatment Plant Hydrated Lime Systems / Corrosion Control Strategy

PREPARED FOR: Lynnann Stapleton, City of St. John's

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DATE: March 3, 2008

PROJECT NUMBER: 121441

Executive Summary

After a complete review of the existing Windsor Lake WTP Corrosion Control System consisting of Hydrated Lime followed by Carbon Dioxide, just upstream of the treatment process, a comparison was made with other potential corrosion control alternatives. In addition to this an evaluation for improving the existing system was performed.

The alternatives looked at were hydrated lime, sodium hydroxide and phosphate based inhibitors however most of this memo focuses on the first two. Additional research and analysis can be performed for the third option however this could not be completed in time for this report.

Costs for sodium hydroxide are still very high and uncertain causing this option to be unappealing if not prohibitive.

Improvements to the existing systems are possible and recommended to provide a reliable system that will produce non-aggressive, buffered, finished water that will result in consistent distribution system water quality for all plants.

With minimal modifications, the Bay Bulls hydrated lime system can be utilized upstream of the DAF process.

The ultimate corrosion control process for Petty Harbour needs to be developed only after the filtration train has been finalized.

Introduction

This memo was developed in response to a trip made by Michael Blair and Bill Gierer to St. John's during the week of February 18th, 2008 for the purpose of examining the existing hydrated lime systems at the Windsor Lake and Bay Bull Big Pond Plants. The Petty Harbour plant was reviewed conceptually with the City Management and Operations Staff as well. Note: Windsor Lake and Bay Bulls Big Pond are currently operating systems while the Petty Harbour system is the design phase for a significantly upgrade.

The purpose of this memo is to recommend a preferred corrosion control approach for the Windsor Lake WTP that can be adapted for all of the facilities in an effort to provide consistency in design, operations and maintenance requirements.

Corrosion Control Option Comparison

The options that were discussed for Windsor Lake during the visit are as follows. All of these options employ CO_2 for ultimate pH adjustment.

Option #1 - Maintain Existing Hydrated Lime System (upstream of the membrane system) while providing process and control improvements;

Option #2 - Maintain Existing Hydrated Lime System but relocate it downstream of Membrane System;

Option #3 - Replace Existing Hydrated Lime System with Sodium Hydroxide (NaOH) and place downstream of membranes;

Option #4 - Addition of phosphate based inhibitor (in conjunction with Hydrated Lime for pH adjustment).

Option #5 - Addition of phosphate based inhibitor (in conjunction with Sodium Hydroxide for pH adjustment).

The following Figure provides Pros and Cons for each of the Corrosion Control options.

FIGURE 1
Corrosion Control Options
Pros and Cons

Option	Pros	Cons
OPTION #1 - Hydrated Lime + CO_2 (u/s of Membrane system) MODE OF CORROSION CONTROL - PRECIPITATION	1. Location of the lime system will not have to move 2. Existing Delivery Contract 3. Most cost effective Option for adjusting alkalinity 4. Existing lime silo is in good condition 5. Provides calcium needed for corrosion control 6. In combination with Carbon	1. Lines are prone to clogging if not maintained properly 2. Relatively high maintenance requirements compared to liquids 3. Messy to handle 4. Batching of chemical can lead to control difficulties 5. Added solids loading may cause premature membrane

FIGURE 1
Corrosion Control Options
Pros and Cons

Option	Pros	Cons
	Dioxide, provides a good buffered water necessary for consistent distribution system quality	fouling[2] 6. Precipitation on primary membranes occurs when optimum corrosion control parameters are met[3] 7. Possible implications with respect to membrane warranty 8. Possible limitations on the extent of corrosion control by the fact that the lime system is upstream of all other plant processes 9. Increased solids will impact the secondary membrane operation and potentially the plant treatment efficiency (ie recovery) 10. Higher cleaning intervals may lead to increased chemical costs, increase stress on membranes and potential impacts on overall membrane life.
OPTION #2 - Hydrated Lime + CO_2 (d/s of Membrane System) MODE OF CORROSION CONTROL - PRECIPITATION	1. Existing Delivery Contract 2. Lowest Chemical cost Option for adjusting alkalinity 3. Existing lime silo is in good condition 4. Provides calcium needed for corrosion control 5. In combination with Carbon Dioxide, provides a good buffered water necessary for consistent distribution system quality 6. Solids imparted from lime do not impact membrane system performance / warranty	1. Relocation of Lime system is necessary 2. Lines are prone to clogging if not maintained properly 3. Relatively high maintenance requirements compared to liquids 4. Messy to handle 5. Batching of chemical can lead to control difficulties 6. Required Effort and Cost to relocate equipment for easy dosing downstream of plant 7. Required effort and Cost for relocating Carbon Dioxide

[2] Current turbidity of raw water is less than 0.5 NTU while the turbidity entering the membrane feed trough is greater than 2 NTU

[3] >8.5 pH and >30 mg/l alkalinity (as $CaCO_3$)

[4] Due to low concentrations of calcium existing in raw water.

FIGURE 1
Corrosion Control Options
Pros and Cons

Option	Pros	Cons
	7. Precipative corrosion control is focused where it should be (the distribution system) 8. Precipative corrosion control process can be optimized to meet and exceed future regulations 9. Less solids seen by secondary membranes potentially will lead to lower cleaning frequencies 10. Lower cleaning frequencies can help reduce cost for chemicals and stress on membranes prolonging the life of the membranes.	dosing downstream of plant. 8. Lime downstream of system will lead to elevated turbidity levels in the finished water
OPTION #3 – Sodium Hydroxide + CO_2 (d/s of membrane system) MODE OF CORROSION CONTROL - PASSIVATION[4]	1. System easier to operate and maintain than hydrated lime systems 2. System not susceptible to clogging (however, see item 8. in Cons) 3. No turbidity imparted into finished water 4. System is easier to design and construct	1. Does not have existing sustainable supply of NaOH 2. Cost is significantly higher than Hydrated Lime[5] 3. World supplies are currently short with not indication of the future[6] 4. Even with CO_2, NaOH will provide minimal buffering as compared to hydrated lime 5. Without buffering, fluctuations in distribution system quality may occur 6. Sodium Hydroxide contributes to levels of sodium in water 7. Sodium hydroxide is very corrosion to the tough and needs to be handles with great care 8. Heat tracing, or carrier water required to prevent NaOH from crystallization in lines (increasing complexity of system operation and storage requirements)

[5] $0.43/ kg – Hydrated Lime and $1.00+ / kg – NaOH (active ingredient)
[6] Based on conversations with Alpha Chemicals, Brenntag and EastChem (all in Atlantic Canada and Maritimes)

FIGURE 1
Corrosion Control Options
Pros and Cons

Option	Pros	Cons
		9. NaOH is delivered at elevated temperatures and thus special transportation is required 10. Strength of solution is only 50% m/m so cost of shipping includes shipping of water. 11. Based on volume requirements, additional building space would have to be freed up or provided for storage assuming a realistic delivery schedule (every two weeks)
OPTION #4 – Phosphate based inhibitor + hydrated Lime (d/s of membrane system) MODE OF CORROSION CONTROL - PASSIVATION	1. Hydrated lime dosing only required for pH adjustment to optimum range for metal phosphates generation. 2. Hydrated Lime with CO_2 can provide a stable, buffered pH in the distribution system for optimum phosphate impact	1. Additional Chemical system added to treatment process 2. Additional chemicals added to distribution system 3. See Hydrated Lime cons for Option #2
OPTION #5 – Phosphate based inhibitor + Sodium Hydroxide (d/s of membrane system) MODE OF CORROSION CONTROL - PASSIVATION	1. Hydrated lime dosing only required for pH adjustment to optimum range for metal phosphates generation.	1. Additional Chemical system added to treatment process 2. Additional chemicals added to distribution system 3. See Sodium Hydroxide cons for Option #3

Cost Comparison

It was determined that there is only one company that has the ability to supply sodium hydroxide in Newfoundland (EastChem – distributor for Brenntag). Due to looming shortages and costs for shipping, the cost of this chemical continues to be much higher than hydrated lime. EastChem indicated that they would not be able to give a long term cost for NaOH based on the uncertainty of the market and also would not give volume discounts for multiple tanker loads per month[7]. An example of these costs, showing Windsor Lake WTP, are provided below however the same comparison can be made for Bay Bulls and Petty Harbour as well with similar results. Based on these numbers and the uncertainty of

[7] Based on conversations, during the week of February 18th meeting, this was believed to be the only way that a competitive price for NaOH could be achieved.

supply, sodium hydroxide is hard to justify. Further work has to be completed to understand the cost implications of using a corrosion inhibitor. Based on current understanding, the dosing is site specific and will require full scale testing to fully quantify. If the City is interested, further investigation can be performed.

FIGURE 2
Hydrated Lime vs. Sodium Hydroxide Cost Comparison

Chemical	Dose (mg/l)	Cost ($/month)
Hydrated Lime	35	32,789
Sodium Hydroxide	35	84,954

Note: doses are approximate requirements to achieve 35 – 40 mg/l alkalinity as $CaCO_3$. Based on results of *Windsor Lake WTP – Corrosion Control Study* produced in January 2004 by CH2M HILL for the City of St. John's.

Conclusions

1. Hydrated lime, is the most cost effective way for providing a non-corrosive finished water with buffering capacity to maintain a consistent water quality in the distribution system.
2. Sodium Hydroxide is not currently available in a consistent, reliable supply and therefore the pricings are not stable.
3. Lime downstream of the membrane system is preferred to reduce the likelihood of negative impacts on the membranes, reduce the membrane maintenance requirements, and reduce the impact of calcium carbonate precipitation on the plant equipment.
4. Sodium Hydroxide is the simplest was to provide corrosion control however this process may lead to distribution system problems due to low raw water alkalinity and calcium concentrations which will provide a less buffered water entering the distribution system.
5. Design improvements must be made to the existing system to reduce the potential for clogging, increase the controllability of dosing, better monitor the batch concentration, provide more reliable, consistent dosing (see design basis below for improvements that can be made to the existing WL hydrated lime system).
6. Phosphate based inhibitors can be used to help reduce hydrated lime or sodium hydroxide quantities needed however additional research needs to be completed to understand the required doses and subsequent costs for utilizing an additional chemical in the Windsor Lake Process train.

Recommendations

1. Regardless of the corrosion control method chosen, it should be employed after the membrane treatment process to reduce any potential impact on the downstream process
2. Hydrated lime + Carbon Dioxide should be utilized as the corrosion control solution for Windsor Lake based on the "Best Practice" Design Brief attached[8].

[8] Document developed during February 18, 2008 St. John's visit by Michael Blair and Bill Grierer.

3. The hydrated Lime system should be maintained at the Bay Bull WTP with the addition of Carbon Dioxide. Based on the existing Bay Bulls system, minimal modifications will be required as the current operation is relatively smooth.
4. The ultimate corrosion control process for Petty Harbour needs to be developed only after the filtration train has been finalized.

Hydrated Lime System Best Practice Design Approach

The following document was developed as a deliverable in response to the February 18, 2008 visit by Michael Blair and Bill Gierer. The equipment recommended below is based on the conversations with Windsor Lake and Bay Bulls' Operations and Management staff as well as CH2M HILL's experience in solid based batching/dosing systems.

It is expected that addition conversations will be required based on these recommendations. The details of the design can be discussed once corrosion control approach, for each plant has been finalized.

The recommended system equipment is a follows:

- Lime Silo[1]
- Silo Load Cells (for more accurate measurement of product use)
- Volumetric Feeder (VFD driven)[1]
- Solution Tank[1]
- Peristaltic Feed Pumps (VFD driven)
- Reinforced plastic feed pump suction and discharge hoses[9]
- Flow meters for solution tank feed water, and solution feed pump discharges[1]
- Provide load cell with solution tanks for better batching control (ie. water vs. lime injection into solution tank)
- pH analyzer on treated raw water for trim[10]
- Pressure indicators and transmitters for feed pump discharge lines (with pressure isolation rings (by Ronningen-Petter or Red Valve)[11]
- Feed Pumps flushing water supply system for both, suction and discharge piping
- Carrier water for feed solution discharge (further dilution of lime slurry to reduce likelihood of clogging)[12]
- Associated isolation valves for lime solutions and flushing water piping (appropriate for lime solution with grit)
- Provide a conditioned "dry-air" compressor system for the Silo air fluidizing system[13]

[1] Existing System

[9] Currently not permanent however have been installed by Plant operations staff as of January 2008.

[10] pH analyzer present however not used for trim as it is downstream of CO_2 addition point.

[11] Current system utilizes Pressure indicators however Pressure transmitters would help with additional troubleshooting and trending to ensure consistent flowrates and allow for quicker diagnosis of potential feed pump/piping problems

[12] Currently done on Bay Bulls with success.

[13] Existing System utilizes a compressor however does not utilize refrigeration to produce "dry air"

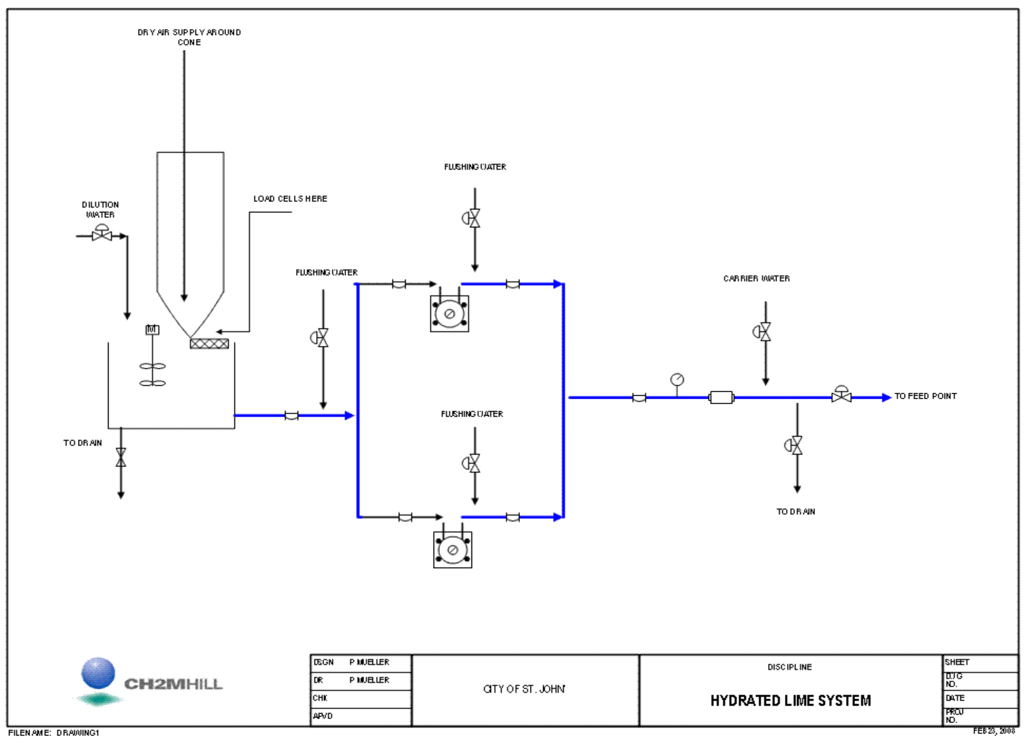
- Motor operated valves for flushing water supply system with flushing waste directed to a waste drain[14]
- Lime Saturator System prior to dosing point[15]

Process Control Narrative for Lime System as follows:

- Lime solution mixing (dry to liquid) will be based on desired solution strength (solution percentage) set by the operator and "batched" automatically.
- Feed Pump feed rate will be based on operator entered dosage and flow paced automatically.
- Flushing water system control will be based on operator entered time delay; start and duration.
- Alarms; high pressure, low flow, high pH/ low pH and equipment faults

[14] To prevent turbidity spikes in effluent.

[15] Particularly important if the lime system is moved downstream of membrane system as increased turbidity is common with hydrated lime systems and is now seen at the Windsor Lake WTP.


DRY AIR SUPPLY AROUND CONE
LOAD CELLS HERE
DILUTION WATER
FLUSHING WATER
FLUSHING WATER
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CARRIER WATER
TO FEED POINT
TO DRAIN
TO DRAIN
CH2MHILL
DSGN P MUELLER
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